FTA RESEARCH

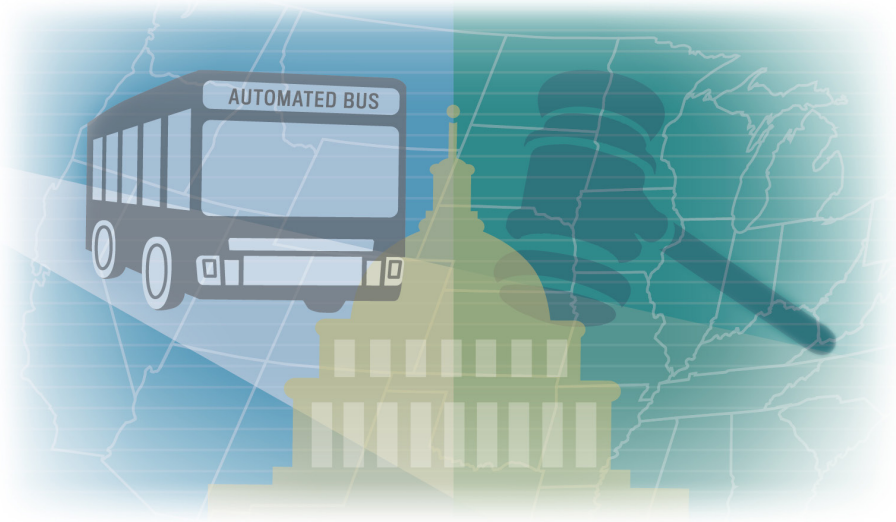
FEDERAL TRANSIT ADMINISTRATION

Transit Bus Automation: State and Local Policy Scan

Final Report

APRIL 2020

FTA Report No. 0162
Federal Transit Administration



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Metric Conversion Table

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liter	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C

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13. ABSTRACT

Although transit bus automation could offer many potential benefits to State and local transit agencies, there may be regulatory, policy, or institutional barriers that could discourage or prevent the deployment of these emerging technologies. This report documents current or anticipated non-technical challenges that State or local transit agencies may experience when implementing transit bus automation projects, summarizes the current State-level regulatory framework for testing and operating automated vehicles, and provides recommendations for mitigating identified challenges and barriers.

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ABSTRACT

Although transit bus automation could offer many potential benefits to State and local transit agencies, there may be regulatory, policy, or institutional barriers that could discourage or prevent the deployment of these emerging technologies. This report documents current or anticipated non-technical challenges that State or local transit agencies may experience when implementing transit bus automation projects, summarizes the current State-level regulatory framework for testing and operating automated vehicles, and provides recommendations for mitigating identified challenges and barriers.

EXECUTIVE SUMMARY

Although transit bus automation capabilities are rapidly advancing, there are several non-technical barriers and challenges that may prevent or discourage transit agencies from investing in emerging technologies. These barriers could be laws, regulations, or policies, at the Federal, State, or local level, as well as institutional issues or longstanding practices. This report documents the results of research and stakeholder interviews on State and local policies, with a focus on those that may pose challenges to, or require revision in light of, the deployment of transit bus automation technologies by transit agencies in the United States. Through this process, insight was also gained on State- and local-level perspectives regarding barriers and challenges that are relevant at the Federal level.

Key findings in this report include the following:

- State and local issues were not seen as major barriers relative to Federal issues. This finding could be due, in part, to the need to use Federal funding to implement projects, a lack of first-hand experience with automation technologies, or the degree of control an agency has in addressing each issue.
- Existing State and local legislation and regulations regarding automated vehicles are diverse but generally do not explicitly consider transit applications. The extent to which legislation facilitates or impedes the deployment of automated vehicles varies widely by state, and it is likely that approaches will continue to evolve over the coming years.
- Transit agencies vary in their plans and priorities regarding automation, which influences their overall approach to potential policy barriers.

Through stakeholder interviews and an analysis of input received via a Federal Transit Administration (FTA) Request for Comments (RFC), it was found that many challenges faced by States and local agencies (e.g., transit agencies) when deploying advanced technologies are "soft barriers"—institutional, structural, attitudinal, or political—rather than legal or regulatory. These barriers include:

- Workforce, training, and labor
- Market readiness and product availability
- Business case
- Risk aversion
- Limited resources
- Data access, management, storage, and sharing
- Fare payment

Potential mitigations to these challenges could include assessing opportunities to address identified Federal barriers, encouraging an active dialogue among key stakeholders, and leveraging planned research and programs to better address issues at all levels of government.

SECTION

1

Introduction

In January 2018, the Federal Transit Administration (FTA) published a Strategic Transit Automation Research (STAR) Plan,[1] which documents FTA's proposed research agenda through 2022 for partial and full automation of transit buses. Part of the STAR Plan's program of research is understanding non-technical barriers and challenges that may prevent transit agencies from investing in automation. These barriers could be laws, regulations, or policies, at the Federal, State, or local level, as well as institutional issues or longstanding practices. The FTA transit automation research team (hereinafter referred to as the "research team"), which consists of FTA staff and members of the John A. Volpe National Transportation Systems Center (Volpe Center), has begun to identify and analyze these potential issues and provide recommendations for needed guidance, revisions, or development of new policies.

This report documents research on State and local policies, with a focus on policies that may pose challenges to, or require revision in light of, the deployment of transit bus automation technologies by transit agencies in the US. Through this process, insight was gained on State- and local-level perspectives regarding barriers and challenges that are relevant at the Federal level. The results presented in this report are not intended to be exhaustive but rather to analyze representative examples in a range of contexts.

Methodology

In January 2018, FTA posted a Request for Comments (RFC) on the Federal docket asking for information on barriers that stakeholders have experienced and how to overcome them.[2] FTA received several dozen comments covering areas from accessibility standards to Federal procurement rules. The research team reviewed these responses to determine potential issue areas that could warrant further review and to identify agencies or organizations that could provide more detailed information. Previous research findings were also used to validate and expand the list of topics of interest.

Following this initial scan, the team conducted a series of interviews with transit agencies and associations. These interviews were part of a targeted follow-up effort to understand these issues in greater depth and to address some of the gaps in the information received from the RFC responses. Additional information regarding RFC respondents and interviewees can be found in Appendix A.

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[1]Federal Transit Administration (2018), "Strategic Transit Automation Research Plan," U.S. Department of Transportation. Washington, DC Available online: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/114661/strategic-transit-automation-research-report-no-0116_0.pdf, last accessed 1/14/2019.

[2]Vehicle Automation Requests for Comment, https://www.transit.dot.gov/research-innovation/vehicle-automation-requests-comment.

Finally, to develop a broader understanding of potential responses to barriers or challenges, the team conducted a brief review of how similar issues were addressed overseas in a well-known transit automation project. A summary of findings can be found in Appendix B.

SECTION

2

Key Findings

State and local issues were not seen as major barriers. Overall, RFC respondents and interviewees characterized Federal issues as more pressing than local issues. They were able to identify multiple Federal issues as current or potential barriers but offered relatively few State and local barriers.[3]

Although RFC respondents generally did not comment on the balance between issues at different levels of jurisdiction, the research team believes the focus on Federal considerations may be due to the following factors:

- Federal funds represent a significant source of capital[4] for transit agencies; thus, overcoming barriers to use Federal funding is a priority. Many agencies may be unwilling to pursue a technology for which they cannot use Federal funding.
- Very few transit agencies have begun to explore automation research, so they may not identify State- or local-level issues until they have first-hand experience with implementing a project or purchasing a vehicle.
- Federal issues may be more salient because they are more difficult for transit agencies to influence. State and local issues can, at least in theory, be overcome if there is enough support for the project (e.g., through modifications to transit agency policies or new State legislation), but it is more difficult to effect changes to Federal law or policy.

Existing State and local legislation and regulations regarding automated vehicles are diverse, but generally do not explicitly consider transit applications. It is likely that these approaches will continue to evolve over the coming years. This lack of clarity may discourage some agencies from moving forward, although none of the interviewees identified local legislation (or the lack thereof) as a barrier. Conversely, interviewees in states with a pro-automation stance (e.g., Arizona and Florida) seem to be benefitting from clarifying legislation (or Executive Orders) as well as State support and funding.[5]

Transit agencies vary in their priorities and goals for automation, which may influence their approach to State and local barriers. For example, several agencies

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[3]Following the analysis of RFC responses and stakeholder interviews, FTA published a series of frequently asked questions to address the impact of new technologies on transit agencies, employees, riders, and the general public. Available online: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/134506/transit-bus-automation-faqs_0.pdf.

[4]Federal Transit Administration (2017), "2017 Funding Sources—National Transit Database," U.S. Department of Transportation, Washington, DC. Available online: https://www.transit.dot.gov/ntd/data-product/2017-funding-sources Last Accessed 1/10/2019.

[5]Although not considered a barrier by the interviewee, a proposed Florida bill regarding remote operation (FL H 353), which failed in January 2018, was cited as an example of desired legislation.

described automation as an opportunity to address low ridership challenges and gain public support by demonstrating advanced technology. Innovative smaller vehicles may be a good fit for routes that routinely have low ridership or for areas where service is not currently viable. By contrast, other agencies expressed less interest in transit bus automation in the near term, at least in part due to the general technical challenges of operating in complex urban environments and structural factors such as strong unions. These interviewees noted that their immediate priorities include addressing state of good repair issues for infrastructure and vehicles and serious funding and debt payment challenges. Investing in unproven technologies was seen as a low priority. Rather than pursuing full automation, these agencies may be more likely to begin with testing and adoption of advanced driver assistance (ADAS) technologies (SAE L0-L2),[6] which could support safety goals with relatively less impact on existing procurement, maintenance, and staffing processes. These ADAS technologies raise fewer concerns about State and local policy barriers.

[6]SAE International (2018), "J3016_201806: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles," SAE International Standard. Available online: https://www.sae.org/standards/content/j3016_201806.

SECTION

3

State and Local Automation Regulatory Landscape

Automated vehicle technologies have been received with varying levels of enthusiasm by elected officials across the country. Although some States have adopted an open-door approach regarding the deployment of emerging technologies, others have been more restrained, largely due to safety and labor concerns.

For both automated and non-automated vehicles, the Federal Government works together with State and local agencies in ensuring the safety of the transportation system. In general, Federal agencies are responsible for regulating the safety performance of vehicles and vehicle equipment as well as their commercial operation in interstate commerce, whereas States and local governments play the lead role in licensing drivers, establishing rules of the road, and formulating policy in tort liability and insurance. To help further define these roles and provide a roadmap for ongoing collaboration, the U.S. Department of Transportation released "Preparing for the Future of Transportation: Automated Vehicles 3.0" (AV 3.0) in late 2018.[7] This document provides guidance for the safe integration of automation into the multimodal surface transportation system. With regard to transit bus automation, AV 3.0 emphasizes the importance of a needs-based approach to implementation that prioritizes accessibility and recognizes emerging workforce needs and requirements.

Many States have current or planned legislation to address the testing and deployment of automated vehicles. As of October 2019, 40 states and the District of Columbia have enacted either legislation or executive orders pertaining to automated vehicle technologies (Figure 3-1).[8]

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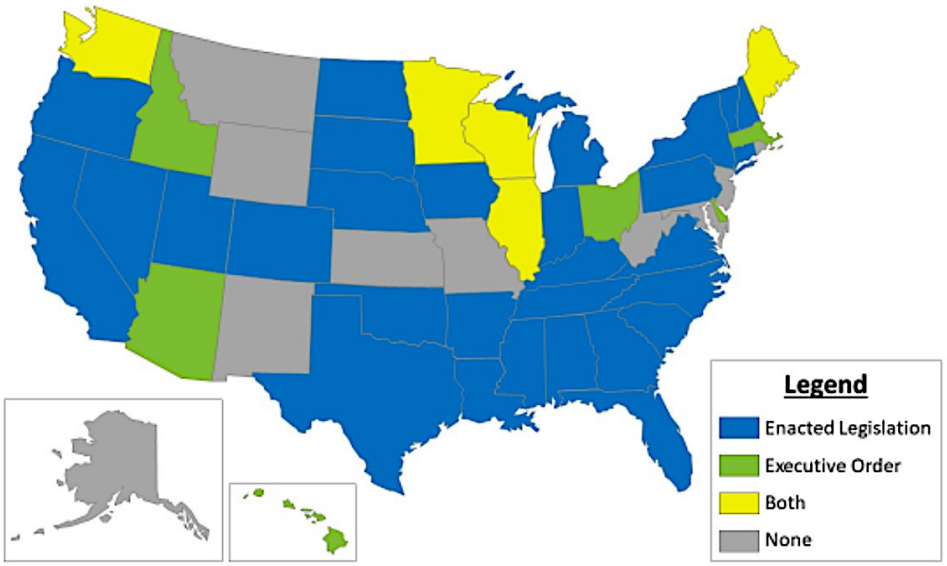
[7]U.S. Department of Transportation (2018), "Preparing for the Future of Transportation: Automated Vehicles 3.0." Available online: https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf.

[8]National Conference of State Legislatures (2019), "Autonomous Vehicles: Self-Driving Vehicles Enacted Legislation." Available online: http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx.

Figure 3-1

States with autonomous vehicles enacted legislation and executive orders



Source: National Conference of State Legislatures (2019)

The extent to which legislation facilitates or impedes the deployment of automated vehicles varies widely by state. Some states (e.g., Florida) have eliminated the requirement that a driver must be present in the vehicle, whereas others set strict requirements for the testing and operation of automated vehicles. In some cases, states have refrained from defining specific regulations in favor of establishing committees to study potential impacts prior to moving forward.

In general, most existing laws seek to guide testing and pilot studies and to establish commissions to study the implications of automated vehicle technologies. Much of this legislation has focused on ensuring safe vehicle operations by addressing factors such as vehicle speed, the presence of an operator, system failure events, and Federal Motor Vehicle Safety Standards (FMVSS) compliance. Additionally, some legislation has been developed to adapt laws predicated on the assumption of human-operated vehicles (e.g., a requirement to have one hand on the steering wheel at all times) to more readily deploy evolving technology. Currently, the primary focus of legislation has been on passenger automobiles, and the extent to which these laws apply to transit vehicles is unclear. However, some states (e.g., Washington, Florida) are beginning to pass legislation that explicitly considers other forms of automated transportation (freight, aviation, transit, passenger rail and ferries, and points of convergence with connected, shared and electric vehicles).[9]

[9]State of Washington, Office of the Governor, "Governor's Autonomous Vehicle Workgroup," https://www.governor.wa.gov/sites/default/files/documents/GovernorsAutonomousVehicleWorkgroup.pdf

SECTION

4

State and Local Issues Identified

This section provides an overview of identified non-Federal issues, many of which are "soft" barriers—institutional, structural, attitudinal, or political—rather than legal or regulatory.

Workforce, training, and labor.[10] Across all industries, the impact of automated vehicles on professional drivers is unclear. However, this ambiguity is particularly acute in the transit industry, where human operators take on many additional non-driving responsibilities, such as providing services to persons with disabilities, monitoring fare payment, supporting maintenance, and ensuring passenger safety and security. Additionally, many transit workers are unionized, which may create additional challenges to be resolved. For example, one interviewee noted that their agency cannot provide service with a non-unionized employee on an existing route that uses unionized employees. Bus routes and operator assignments are set by contract and cannot be easily changed.

Transit bus automation will likely result in new and modified job categories for agency staff. These changes could include a transition in the operator role from active driving to a more customer-service oriented role, as well as the creation of new positions to support the operation and maintenance of advanced technology systems. Many agencies interviewed expressed the need for frequent and early engagement with the labor community to address potential impacts to workers. There was also a perception among agencies that, although automation may not produce outright labor cost savings, it could yield improvements to customer service and transit service. See Appendix B for an illustrative example.

Market readiness and product availability.[11] Multiple agencies noted the limited market availability of automated transit bus technologies. In particular, the lack of built-in accessibility features was identified as a key concern, especially as many transit agencies view automation as a potential solution for paratransit and other underserved communities. There may be a mismatch between research

[10]A forthcoming Transit Cooperative Research Program (TCRP) study will provide additional information to the public transportation industry regarding potential impacts of automation on the labor force (*TCRP J-11/ Task 34:* The Effects of Vehicle Automation on the Public Transportation Workforce).

[11]In October 2019, FTA published "Transit Bus Automation Market Assessment," which conveys the state of automated transit bus technology in terms of its availability, capabilities, and limitations to inform FTA, transit agencies, and other transit industry stakeholders interested in understanding the market. Available online: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/134451/transit-bus-automation-market-assessment-fta-report-no0144.pdf.

and development activity in the automation industry, which has concentrated on smaller vehicles such as automated shuttles, and the need of many agencies for full-size buses. Although there is an emerging market for automated shuttles, some agencies expressed hesitation regarding the relatively high costs and unclear business cases associated with these vehicles, especially for larger cities and higher ridership routes. With limited funding available, agencies may opt to pursue more proven improvements to vehicles and service while waiting for the automated vehicle market to further mature.

Business case. Making the business case for automation depends in part on alignment with agency goals. For some agencies, automation may not be seen as a solution to key challenges, such as making payments on existing debts, equipment and infrastructure degradation, or declining ridership. Such a mismatch will naturally limit the agency's motivation to pursue automation in the early phase. For example, one agency identified its key bus-related problems as roadway congestion (which limits bus speeds), clearing incidents, double-parking at stops, managing passenger conflict, and fare payment. Automation is unlikely to directly address these issues. Other priorities include emissions and accessibility; automation's ability to address these issues is still unclear.

Risk aversion. Transit agencies have a highly public role, and many may be hesitant to invest in a risky and potentially controversial technology solution. Some agencies expressed skepticism that the technology could mature to the point where operations in complex urban environments would be possible, as well as acceptable to stakeholders. Agencies may prefer to focus on more traditional improvements to their services, rather than taking on the risks of an early adopter.

Limited resources. Introducing a new vehicle and operational model can have ripple effects throughout the agency. The difficulty of making such changes for a large organization may be so significant as to discourage early adoption. For example, although automation might enable a conventional hub-and-spoke bus network to be replaced with point-to-point services using smaller vehicles, many agencies would find it difficult to conduct the network planning and stakeholder consultation that would be required to implement such sweeping changes to their service. Such efforts would require considerable resources and would compete with other pressing transit needs.

Data access, management, storage, and sharing. Many interviewees discussed the need for more guidance regarding data governance. It is increasingly common for State and local agencies to form partnerships with private transportation service entities, often with the public agency receiving access to data in exchange for permission to operate on public roadways. The collection and use of data has been a concern for private manufacturers and public agencies alike, but a clear framework for these issues has not been established. At the

local level, at least one agency interviewed identified a conflict between a State requirement to store vehicle data for 30 days and the ability of a demonstration vehicle to store only 48 hours of data. Requirements created for simpler, less data-intensive systems may require modification in light of automated systems. Conversely, the vast datasets generated from automated vehicle sensors and cameras will need to be managed carefully to avoid civil liberties concerns and other issues.

Fare payment. In many transit systems, operators are responsible for managing fare payment. Agencies may need to implement new technologies to ensure proper revenue collection in situations where a human operator is not present. This issue falls under the larger category of non-driving functions typically performed by a transit bus operator and could be addressed either through technology and policy innovations (e.g., a proof-of-payment system) or through a system in which an operator remains present on a vehicle but with a shifted focus toward customer service.

SECTION

5

Recommendations

Based on input received from interviews and RFC responses, following are recommendations that could help policymakers and deployers better understand and respond to the challenges discussed in this report.

Assess opportunities to address identified Federal barriers. Federal policy issues are the primary issues identified by stakeholders and are generally within USDOT's jurisdiction to address, whereas State and local governments typically can resolve local issues if there is political will to move forward.

Continue the dialogue with stakeholders. As transit grantees explore bus transit automation further, they are likely to encounter new issues. Some of those issues may be candidates for FTA-sponsored research, which could help inform development of local policies and programs. Regular communication among States, localities, FTA Regions, and FTA Headquarters could help stakeholders keep abreast of emerging issues.

Leverage planned research and programs to better address State and local issues. Through the STAR Plan, FTA has outlined several key activities focused on the topics noted in the previous section. Table 5-1 shows the alignment between planned FTA research and each identified issue.

Table 5-1

Current and Planned FTA Activities to Address State and Local Concerns

State and Local Concerns	STAR Plan Activities
Workforce, Training, and Labor	• Automated Transit Labor Impacts Assessment • Automated Transit Labor Impacts Evaluation
Market Readiness and Product Availability	• Market Analysis for Automated Transit Buses and Supporting Systems • Integrated Demonstration 1: Automated ADAS for Transit Buses • Integrated Demonstration 2: Automated Shuttles • Integrated Demonstration 3: Automation for Maintenance and Yard Operations • Integrated Demonstrations 4a, 4b, 4C: Automation for Mobility on Demand • Integrated Demonstration 5: Automated Bus Rapid Transit • Accessibility Analysis
Business Case *Funding Availability*	• Business Case for Transit Automation • Finance Options for Automated Transit Investments • Transition Costs & Planning for Automated Transit Bus Deployment
Risk Aversion *Political Support* *Institutional Inertia* *Dense Urban Navigation*	• Transit Automation User Acceptance Study and Human Factors Research • Integrated Demonstration 1: Automated ADAS for Transit Buses • Integrated Demonstration 2: Automated Shuttles • Business Case for Transit Automation • Standards Assessment and Coordination • Security & Customer Acceptance Implications of Automated Transit Buses
Data Access, Management, and Storage	*Addressed through coordination with USDOT's Intelligent Transportation Systems Joint Program Office*
Fare Payment	• Integrated Demonstrations *Addressed through other FTA initiatives (Integrated Mobility Innovation and Accelerating Innovative Mobility)*
Federal Legislation	• Automation Policy Implementation • Stakeholder Guidance Updates

APPENDIX

A

Stakeholder Outreach

FTA-2017-0025: Removing Barriers to Transit Bus Automation received 43 comments, and FTA-2017-0024: Research Program: Automated Transit Buses received 55 comments. Although the latter RFC did not focus directly on barriers to transit bus automation, some organizations provided additional context for the issues summarized in this report. Based on the RFC responses and findings from related research, the team conducted a series of interviews with transit agencies and other relevant organizations.

Stakeholder groups interviewed for this report include the following:

- American Public Transportation Association (APTA), October 5, 2018
- New York City Department of Transportation (NYCDOT), October 11, 2018
- Valley Metro Regional Public Transportation Authority (Valley Metro), November 20, 2018
- Jacksonville Transit Authority (JTA) and Florida Department of Transportation (FDOT), November 21, 2018
- San Francisco Municipal Transportation Agency (SFMTA), November 28, 2018
- Massachusetts Department of Transportation (MassDOT), December 7, 2018

APPENDIX

B

Case Study – Rail Transit Automation in Paris

Paris Metro Automation: Organized Labor and Other Institutional Issues

Although there are a handful of automated guideway systems in the United States, there are few (if any) examples of an existing transit service that was later converted to automated operation. Thus, it may be useful to look at transit automation examples from overseas to learn how policy and institutional issues were handled. One well-documented case study is Metro Line 1 in Paris, which was converted to automated operation over the period from 2008–2012. As the transit labor force in Paris is highly unionized, this case study highlights some of the ways that labor issues can be addressed and (despite the differences in transport mode and local context) provides some potential lessons for transit bus automation in the United States.

As background, Metro Line 1 is both the city's oldest Metro line and the most heavily used, carrying about 725,000 passengers per day and serving 25 stations. The line was operated manually until the 1970s, when the agency, Régie Autonome des Transports Parisiens (RATP), introduced various forms of automated train control while still keeping drivers in place.

In 2002, before any decisions were made about automation, consultation with RATP staff began on an overall Metro modernization campaign and potential changes in staffing. In 2004, based on these consultations, RATP approved a conversion to fully driverless operation on Line 1. Labor agreements were signed in 2004 and 2007, laying out the evolution of job roles in the context of automation.[12]

A key element of the labor negotiation was that there would be no layoffs in connection with automation. Drivers were moved to other Metro lines and, in many cases, promoted to supervisory positions, including in the control center for Line 1. Staff are also still needed for remote supervision and for manual operation of the trains in case of a breakdown or emergency.

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[12]Churchill, G., "The Automation of Paris Subway Line 1 Contributes to On-going Modernisation," Intelligent Transport, April 25, 2012. https://www.intelligenttransport.com/transport-articles/7238/the-automation-of-paris-subway-line-1-contributes-to-on-going-modernisation/.

In addition to the automated vehicle control systems, RATP made several investments to handle driverless operation. Security cameras and intercoms were added to the trains to allow control center staff to monitor trains and for passengers to contact the control center. Platform screen doors were added to all stations, and boarding platforms were adjusted to better align with train heights and address curves in station platforms.

Overall, this approach appears to have been successful in allaying concerns about job loss. However, other factors also were important in achieving buy-in from the union. One was the very high occupational stress levels for operators on Line 1, who were under a heavy workload from the close headways and high ridership on the line. Another factor was the extreme psychological distress to operators caused by witnessing suicides on the line. These incidents have been almost completely eliminated by the platform screen doors, and drivers are no longer on the vehicles to witness them first-hand.

Although RATP's approach did not result in labor savings, the automation of Line 1 allowed a number of other objectives to be achieved. First, the more advanced signaling system allowed peak headways to be safely reduced from 105 seconds to 85 seconds and speeds to be increased from 70 km/h to 80 km/h. The platform doors also have reduced dwell times by preventing passengers from blocking boarding doors. Together, these changes have helped meet demand on the line and address issues with crowding and service reliability. Space within the train cars previously occupied by the driver's compartment is now open for passengers, increasing capacity—an effect is that is small but noticeable (about four extra seats plus some standee space). Optimized acceleration and braking from automation operation has also reduced energy consumption by about 15%, and there are safety benefits from the signal upgrades and platform doors. The system is generally more flexible and adaptable; for example, additional metro service can be provided to meet surges in demand without the need to find operators, and service can be extended later into the night without concern for operator duty-hour limitations. Metro service can also continue during the labor strikes that are more common in France than in the United States, although RATP managers noted that this was not an explicit goal of the project.[13]

The Paris experience with Line 1 suggests some overall lessons that may be applicable to the United States. First, it seems clear that early and continued engagement with labor unions is essential and that there will be long lead times for automation investments, both for technical and institutional reasons. Second, transit agencies must clearly identify both their goals for automation and what they can offer to labor to create a win-win situation. In the Paris example, job

[13]Siemens AG, "Fact Sheet: Driverless Metro Paris," press release, April 2012. Available online: https://www.siemens.com/press/pool/de/feature/2012/infrastructure-cities/mobility-logistics/2012-04-metro-paris/factsheet-driverless-metro-paris-en.pdf.

security was assured and employees were given the prospect of promotions, along with diminished workplace stress and trauma, and the agency gained greater throughput, reliability, and energy savings. Some of these factors are less relevant to US transit bus operations, as few bus routes are operating at headways so close as to require automation. However, workplace stress and safety continue to be issues for bus operators, and some portions of the US transit industry are experiencing difficulties with recruiting and retention. Third, the flexibility to add and subtract automated service as needed to match demand, with relatively little lead time and no need for driver staff (or limitations caused by scheduling and work rules), is a major operational advantage for transit agencies that tends not to be covered as much in automation discussions. However, agencies will need to conduct their own assessment of the value of these flexibilities.

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